



COMPARATIVE STUDY OF TRANSVAGINAL SONOGRAPHY AND MAGNETIC RESONANCE IMAGING FOR EVALUATION OF PELVIC ENDOMETRIOSIS

Radiology

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ABSTRACT

Background: Endometriosis is a chronic disease associated with severe, life-impacting pain and having significant social, public health and economic implications. The gold standard for diagnosing deep endometriosis is the laparoscopy, but trans-vaginal sonography (TVS) & Magnetic Resonance Imaging (MRI) are essential tool to diagnose and evaluate extent of involvement. This study was conducted to find out and compare the diagnostic accuracy TVS & MRI in pelvic endometriosis in comparison to the gold standard-laparoscopy or laparotomy at a tertiary level healthcare facility. **Materials & methods:** An institution based descriptive observational study with prospective design was conducted from over year. 40 cases of endometriosis on the basis of subjective symptoms & clinical examination (per-vaginal/ per rectal), were investigated by TVS & Pelvic MRI before laparoscopy or laparotomy. Statistical analysis was performed using the software –MEDCALC-version 20.115. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy were calculated for ultrasonography and MRI in comparison to histopathology. Cohen's kappa value (κ) was used to determine the level of agreement between the index tests and reference standards. **Results:** The mean (SD) age of the study participants was 30.6 (± 5.58) years. In the present study, we observed that the sensitivity, specificity, PPV & NPV were higher in case of MRI compared to USG according to the specific site of involvement in endometriosis. The Kappa's were high ranging from 1 for fallopian tubes involvement indicating high sensitivity of detecting extra-ovarian endometriosis regarding involvement of sacral ligaments, fallopian tubes, POD & pelvic peritoneum and gut wall by MRI compared to TVS. **Conclusion:** MRI correctly diagnosed all cases of endometriosis and with higher diagnostic accuracy than TVS in diagnosing pelvic endometriosis.

KEYWORDS

Endometriosis, trans-vaginal sonography, Magnetic Resonance Imaging, diagnostic accuracy

INTRODUCTION

Endometriosis is a chronic disease associated with severe, life-impacting pain during periods, sexual intercourse, bowel movements and/or urination, chronic pelvic pain, abdominal bloating, nausea, fatigue, and sometimes depression, anxiety, and infertility¹. Endometriosis primarily involves the peritoneum and ovaries and can be classified into three types of lesions superficial endometriosis (peritoneal and/or ovaries), ovarian Endometriomas and deeply rating endometriosis Deep infiltrating endometriosis (DIE). Worldwide, 10% (190 million) of reproductive age women and girls are reported to suffer from endometriosis, and around 26 million in India are reported to have endometriosis¹. There are several studies done in Indian population have shown the incidence of endometriosis varied from 34% to 48% diagnosed by laparoscopy^{2, 3}. Endometriosis has significant social, public health and economic implications. It may reduce the quality of life due to severe pain, fatigue, depression, anxiety and infertility. Better awareness, followed by early diagnosis and management may lower or halt the natural progression of the disease and reduce the long-term burden of its symptoms, as there is now know way for prevention of the disease. Pelvic Endometriosis cases are frequently found in the outpatient department. They need to be screened further to determine their nature as early as possible for the benefit of patients. Pre-Operative trans-vaginal Ultrasonography (TVS) is an effective and easy way of achieving the same. But despite this, laparoscopy remains the most definitive method for determining the character of endometriosis. However, it is an invasive method & cannot comment on the depth of involvement of pelvic endometriosis; where magnetic resonance imaging has an advantage.

The gold standard for diagnosing deep endometriosis is the laparoscopy, but Magnetic Resonance Imaging (MRI) is an essential tool to diagnose and evaluate extent of involvement⁴. There are several studies available in the literature comparing the efficacy of trans-vaginal sonography & magnetic resonance imaging in diagnosing pelvic endometriosis but most of the studies are reported from outside India. Very few studies are reported from eastern India. In this context the current study was conducted to find out and compare the diagnostic

accuracy of trans-vaginal sonography & magnetic resonance imaging in pelvic endometriosis in comparison to the gold standard-laparoscopy or laparotomy at a tertiary level healthcare facility.

MATERIALS AND METHODS:

The present institution based descriptive observational study with prospective design was conducted from January 2021 to June 2022 at the Department of Radio-diagnosis & Department of Obstetrics & Gynaecology, Institute of Post Graduate Medical Education & Research and SSKM Hospital, Kolkata. The study populations were the cases with Clinical features and suggestive pelvic examination findings of Endometriosis and undergoing laparoscopy in the department of Obstetrics & Gynaecology of same institute. The inclusion criteria of the subjects were: a) Presenting with any one of the symptoms (from moderate to severe) associated with DIE (chronic pain, dysmenorrhea, deep dyspareunia and dyschezia), and b) presence of one or more lesions identified as DIE at clinical or imaging evaluation (TVS & MRI). The excluded categories of cases were the patients who can be treated with medical therapy, virgins or who had genital malformations, Contraindication for MRI & Laparoscopic surgery and refusing to provide informed consent.

The required sample size was calculated using the formula for descriptive observational study, where assumed prevalence of Pelvic Endometriosis about 10 to 30% the population¹, Confidence Level 95%, 10% type 1 error and the required sample size was 35 and with 10 percent non-response rate the final minimum sample size was 40. The eligible study populations were examined in the Gynaecology OPD, followed by referral to the department of Radio-diagnosis for TVS & Pelvic MRI, and patients undergoing Laparoscopy in the department of Gynaecology were approached and after fulfilling the inclusion and exclusion criteria, subjects were included in the study till the desired sample size was reached within the study duration. After obtaining all the necessary approvals and ethical clearance and informed consent from each study participants, data were collected using a pre-designed and pre-tested schedule to record the findings of clinical features, imaging & post-operative biopsy. Women suspected of having deep

pelvic endometriosis on the basis of subjective symptoms & clinical examination (per-vaginal/ per rectal), were investigated by TVS & Pelvic MRI before laparoscopy or laparotomy. Trans-abdominal ultrasound examination was first done after obtaining verbal consent & using GE healthcare LOGIQ P9, equipped with a 4- 8MHZ abdominal probe & a trans-vaginal 5-9MHZ probe and after proper bowel preparation. A trans-abdominal Scan followed by trans-vaginal sonography was performed in all cases of suspected pelvic endometriosis. Magnetic resonance imaging was performed on a 3T MRI device (GE Signa Explorer GE Healthcare) using a pelvic phased array coil. MRI checklists were filled and obtaining consent followed by proper bowel preparation and outside the menstrual period.

All operative interventions were performed after whole bowel preparation under general anesthesia followed by histopathology examination. Follow-up of the patients was also done, and results of ultrasound and MRI were compared with histopathology after laparoscopic surgery was done in these patients. The recorded data was compiled and entered in a spreadsheet (Microsoft Excel). Statistical analysis was performed using the software –MEDCALC -version 20.115. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy were calculated for ultrasonography and MRI in comparison to histopathology. Cohen's kappa value (κ) was used to determine the level of agreement between the index tests and reference standards regarding the presence or absence of DE lesions in all individual areas of the pelvis. The agreement was interpreted based on guidelines by Altman⁵: $\kappa < 0.20$, poor agreement; 0.21–0.40, fair agreement; 0.41–0.60, moderate agreement; 0.61–0.80, good agreement; 0.81–1.00, a very good agreement.

RESULTS:

The present institution based descriptive cross-sectional study was conducted among 40 cases of Endometriosis. The mean (SD) age of the study participants was 30.6 (± 5.58) years. We found that most of the subjects were aged between 20-30 years (64%) and 22% were in the age group of 30-40 years; while, 14% of the women were more than 40 years of age (Figure 1). Among the patients, 10% patients were having uterine fibroid and 6% with adenomyosis (Figure 2). The study observed that MRI was able to diagnose higher number of cases in comparison to USG with reference to the gold standard of diagnosis among the subjects. In the present study, we observed that the sensitivity, specificity, PPV & NPV were higher in case of MRI compared to USG according to the specific site of involvement in endometriosis (Table 2 & 3).

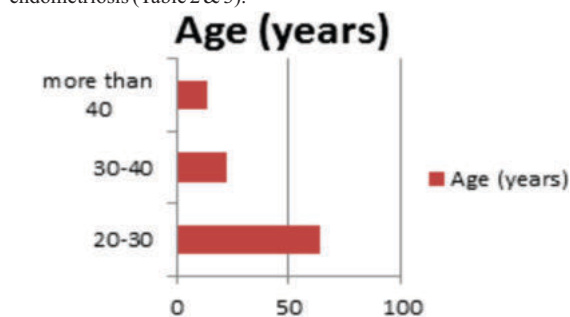


Figure 1: Distribution of study subjects according to age (n=40)

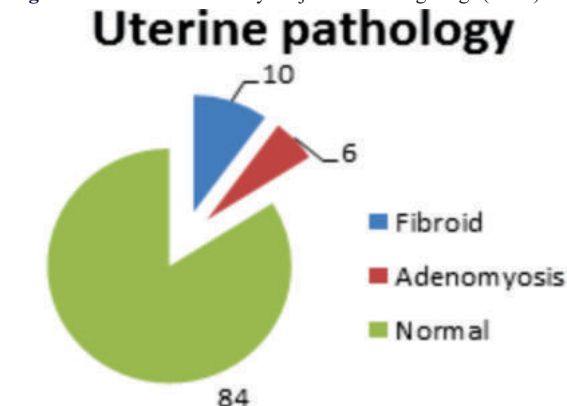


Figure 2: Distribution of study subjects according to Uterine pathology (n=40)

Among the patients, 10% patients were having uterine fibroid and 6% with adenomyosis.

Table 1: Frequency comparison of diagnosing the specific site in endometriosis by TVS, MRI and laparoscopy & histopathology (gold standard) (n=40)*

Sites of involvement	TVS n=40	MRI n=40	Gold standard n=40
Ovaries	27	29	29
Fallopian tubes	06	08	08
Utero-sacral ligaments	04	04	05
POD & pelvic peritoneum	01	04	03
Gut wall	02	04	04
Anterior abdominal wall (other)	-	02	02

*-multiple responses, POD- pouch of Douglas

Table 2: Validity of TVS in endometriosis by the sites of involvement (n=40)

Sites of involvement	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Kappa	Accuracy (%)
Ovaries	93.1	100	100	84.6	0.88	95
Fallopian tubes	75	100	100	94	0.82	95
Utero-sacral ligaments	40	94.2	50	91	0.37	87.5
POD & pelvic peritoneum	25	100	100	92.3	0.37	92.5
Gut/rectal wall/others	25	97	50	92	0.28	90

PPV-Positive predictive value, NPV-Negative predictive value

Table 3: Validity of MRI in endometriosis by the sites of involvement (n=40)

Sites of involvement	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Kappa	Accuracy (%)
Ovaries	100	100	100	100	1	100
Fallopian tubes	100	100	100	100	1	100
Utero-sacral ligaments	60	97	75	94	0.50	92.5
POD & pelvic peritoneum	50	97.2	66.6	94.5	0.53	92.5
Gut/rectal wall/others	50	94	94	94.4	0.44	90

PPV-Positive predictive value, NPV-Negative predictive value

The sensitivity and specificity of USG in diagnosing extra ovarian endometriosis were - for fallopian tube 75% and 100%, for utero-sacral involvements 40% and 94.2%, for POD & pelvic peritoneum 25% and 100% and for gut wall 25% and 97%. MRI in diagnosing extra-ovarian endometriosis were- for fallopian tube 100% and 100% for utero-sacral involvements 60% and 97% for POD & pelvic peritoneum 50% and 97.2% and for gut wall 50% and 94% (Table 2 & 3).

DISCUSSION:

Endometriosis is a serious and common estrogen-dependent chronic inflammatory disease associated with lesions of functional endometrial-like tissue at ectopic sites of the pelvic cavity⁶. One of the key challenges in controlling the disease is the long delay, typically several years, between the symptoms onset and the diagnosis⁷. In the present study, we investigated the diagnostic accuracy of 2 non-invasive modalities for pelvic endometriosis. Although laparoscopy and histopathologic examination is the criterion standard for pelvic endometriosis, but it is invasive and requires preoperative planning. MRI and TVS are non-invasive modalities, which are available and feasible. In addition, early diagnosis of DIE is an important predictor of outcome and quality of life. In this institution based descriptive cross-sectional study, 40 patients with clinical suspicion of pelvic endometriosis were studied. The findings of the study are being discussed with other studies done here and abroad.

Among 40 patients, the mean (SD) age of the study participants was 30.6 (± 5.58) years and majority (64%) of the patients were in the age group of 20-30 years. This finding of the study corresponds to study done by Puri S et al⁸, which observed mean age was 31.45 $\pm$ 4.44 years. Kruger et al. in their study reported that the average age was 33.5 $\pm$ 6.1 years⁹.

In this study, we specifically looked for Endometriotic involvement of ovaries, fallopian tubes, POD & pelvic peritoneum, gut wall and urinary bladder. We found 2 cases of umbilical endometriosis. Among the 40 diagnosed patients involvement of specific sites as per the gold standard diagnosis, Ovaries were found to be the commonest site of involvement, followed by, fallopian tubes, uterosacral ligaments, POD & pelvic peritoneum and gut wall involvement. Diagnosis of Endometriotic involvement of ovaries (Endometrioma) in USG and MRI revealed identical results. All 40 patients were diagnosed by USG and MRI and confirmed by gold standard.

The sensitivity of diagnosis Endometrioma in USG and MRI were 93% & 100% each modality respectively. Indrielle Kelly et al¹⁰ in their study found 100% sensitivity Of MRI in detecting Endometrioma, which is in concordance to our study. Nisenblat et al reported the diagnostic accuracy of trans-vaginal USG and MRI for ovarian endometriosis, where the sensitivity and specificity of ultrasound for ovarian endometriosis were 93 and 96%, respectively, and MRI were 95 and 91%, respectively¹¹. During comparison of diagnosis of extra-ovarian endometriosis we found USG diagnosed 6 case of fallopian tube involvement while MRI diagnosed 8 cases. Similarly, 4 cases of involvement of utero-sacral ligaments were diagnosed correctly by MRI while USG detects 4 cases. 4 cases of POD & pelvic peritoneum involvement were diagnosed in MRI, whereas USG detected 1 pelvic peritoneum involvement. While we compared the diagnostic indices, we found the sensitivity and specificity of USG in diagnosing extra ovarian endometriosis were as follows for fallopian tube 75% and 100%, for utero-sacral involvements 40% and 94.2%, for POD & pelvic peritoneum 25% and 100% and for gut wall 25% and 97%. Alborzi et al¹² found sensitivity of TVS for detecting involvement of USL 70.9%, gut wall 88.4%, pod & pelvic peritoneum 52%. Whereas when, we compared the diagnostic indices, we found the sensitivity and specificity of MRI in diagnosing extra-ovarian endometriosis were as follows for fallopian tube 100% and 100% for utero-sacral involvements 60% and 97% for POD & pelvic peritoneum 50% and 97.2% and for gut wall 50% and 94%. The Kappa's were high ranging from 1 for fallopian tubes involvement indicating high sensitivity of detecting extra-ovarian endometriosis regarding involvement of sacral ligaments, fallopian tubes, POD & pelvic peritoneum and gut wall by MRI compared to TVS. Indrielle et al¹⁰ found sensitivity of MRI for detection of involvement of USL, gut wall, pelvic peritoneum 74%, 67% & 67% respectively. As we had previously discussed the diagnosis of Endometriomas was not very different in both the modalities- USG and MRI. Involvement of left ovary was found to be slightly more than the right ovary. As we compared this study with the results from the previous studies it was found that sensitivity of TVS in diagnosing Endometrioma was always very high and it had equal sensitivity of MRI.

The study by Fratelli N¹³ observed that among 429 women with deep endometriosis, Sensitivity and specificity of TVS were 61% and 99%, respectively, for bladder endometriosis, 52% and 96% for endometriosis of recto-vaginal septum, 65% and 99% for rectum endometriosis, and 69% and 98% for endometriosis of the sigmoid colon. However, in diagnosis of DIE lesions in specific locations such as POD and retro cervical areas, utero-sacral ligaments adjacent gut wall involvement there were conflicting result in comparing the accuracy of USG and MRI. All the studies did not specifically look for these sites for involvement and some studied additional sites like recto-vaginal septum, vaginal walls. Different studies had been done in different strength of MRI (1T and 1.5T). However, all the previous studies specially the meta-analysis done by Guerriero et al¹⁴ showed high sensitivity of detecting DIE lesions by TVUS. In our study we TVS can surely diagnose Endometrioma confidently but in diagnosing DIE such as involvement of utero-sacral ligaments, POD, gut wall it showed a very poor results with low sensitivity and kappa values. Regarding MRI diagnosis of deep pelvic endometriosis some study showed MRI was less sensitive than TVS, but most studies confirmed that MRI was as sensitive as or better than TVS, specially diagnosing the involvement of utero-sacral ligaments. In our study we found MRI was helpful in detecting Endometrioma as well as extra-ovarian pelvic endometriosis specially involvement of utero-sacral ligaments, POD, gut wall invasion and also the involvement of fallopian tubes (hematosalpinx or hydrosalpinx) with a confidently high Kappa values ranging from 0.716 to 1.000. The limitation of our study was that the number of patients in our study involving different sites especially bowel, peritoneum, utero-sacral ligaments were few hence larger study population is recommended to validate the results.

CONCLUSION:

Ultrasonography, especially TVS can diagnose ovarian endometriosis (Endometrioma) correctly, thus helping in diagnosis in clinically suspected patients. However, TVS had very low sensitivity in diagnosing extra ovarian deep pelvic endometriosis. MRI (3T) correctly diagnosed all cases of endometriosis. MRI also showed high sensitivity in diagnosing pelvic endometriosis in the form of involvement of utero-sacral ligaments, POD, gut walls, fallopian tubes with high Kappa values. Ultrasound can be regarded as a first-line investigation in endometriosis followed by MRI to evaluate the extent of disease and make accurate diagnosis for indeterminate cases and deep endometriosis.

Conflict of Interest: None to declare

Source of Funding: Nil

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